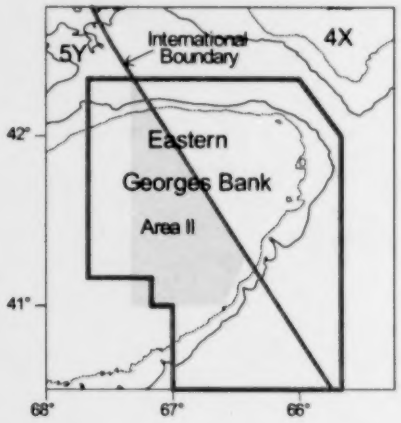
EASTERN GEORGES BANK HADDOCK

[5Zjm; 551,552,561,562]



Summary

- Combined Canada and USA catches in 2006 were 12,642 mt.
- Adult biomass (ages 3+) increased from 8,500 mt in 1993 to 69,500 mt in 2003. Adult biomass decreased to 46,900 mt in 2005 but subsequently increased to 145,300 mt in 2007, higher than the 1931-1955 maximum biomass of about 90,000 mt.
- The exceptional 2003 year class, estimated at 321.7 million age-1 fish, is the largest observed in the assessment time series (1931-1955 and 1969-2005). The 2001, 2002 and 2004 year classes, at less than 8 million, are below the recent 10 year average of 18 million fish while the 2005 year class, at 30.5 million, is above the average. Initial estimates of the 2006 year class suggest that it is about the size of the 2004 year class.
- Fishing mortality (ages 4+) was below $F_{ref} = 0.26$ during 1995 to 2004. The failure of the 2003 year class to recruit as expected to the 2005 and 2006 fishery resulted in fishing mortality in 2005 and 2006 exceeding F_{ref} (F_{2006}=0.36).
- With expanded age structure, broad spatial distribution and generally higher recruit per spawner ratio, resource productivity is high, negatively impacted only by recent reductions in fish weight at age.
- Assuming a 2007 catch equal to the 19,000 mt total quota, a combined Canada/USA catch of 26,700 mt in 2008 would result in a neutral risk (50%) that the fishing mortality rate in 2008 will exceed $F_{ref} = 0.26$. A catch of 23,000 mt would result in a low risk (25%) that the fishing mortality rate in 2008 will exceed F_{ref}. However, there is high uncertainty in the partial recruitment estimated for the 2003 year class.

Catches, Biomass (thousands mt); Recruits (millions)

		1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Avg[1]	Min[1]	Max[1]
Canada	Quota	3.9	3.9	5.4	7.0	6.7	6.9	9.9	15.4	14.5	12.7			
	Landed	3.4	3.7	5.4	6.8	6.5	6.8	9.7	14.5	12.0		4.5	0.5	14.5
	Discard	0.1	<0.1	<0.1	<0.1	<0.1	0.1	0.1	0.1	<0.1		0.1	<0.1	0.2
USA	Quota[6]							5.1	7.6	7.5	6.3			
	Landed	0.3	0.4	0.2	0.6	0.9	1.6	1.8	0.5	0.4		2.1	<0.1	9.1
	Discard[2]	<0.1	0	0	<0.1	<0.1	0.1	0.2	0.1	0.1		0.9	<0.1	7.6
Total	Quota							15.0	23.0	22.0	19.0			
	Catch	3.8	4.1	5.6	7.5	7.5	8.5	11.8	15.1	12.6		7.2	2.2	23.3
Adult Biomass[4]		23.7	28.9	33.5	44.8	38.0	69.5	64.2	46.9	114.9	145.3	43.0[3]	6.8[3]	145.3[3]
Age 1 Recruits		7.2	24.8	9.0	69.3	3.5	2.0	321.7	7.8	30.5	8.7	27.7[7]	0.5[7]	321.7[7]
Fishing mortality[5]		0.15	0.14	0.17	0.19	0.20	0.20	0.18	0.32	0.36		0.30	0.08	0.59
Exploitation Rate[5]		13%	12%	14%	16%	16%	16%	15%	25%	27%		23%	7%	41%

[1] 1969 - 2006
[2] discards not estimated in 1999-2000 but assumed negligible
[3] 1931 - 1955, 1969 – 2007
[4] Jan 1 ages 3+
[5] ages 4+
[6] for fishing year from May 1 – April 30
[7] 1931 - 1955, 1969 – 2006

Fishery

Under restrictive management measures, **combined Canada/USA catches** declined from 6,522 mt in 1991 to a low of 2,181 mt in 1995, fluctuated between about 3,000 mt and 4,000 mt until 1999 and since increased to 15,112 mt in 2005 (Figure 1). The combined catch in 2006 was 12,642 mt. Greater catches were recorded in the late 1970s and early 1980s, ranging up to about 23,000 mt, but catches subsequently declined and fluctuated around 5,000 mt during the mid to late 1980s.

The **Canadian catch** in 2006 decreased to 12,051 mt from 14,536 mt in 2005. Weight of all Canadian landings was monitored at dockside. At-sea observers monitored 31% of the total haddock landed in 2006, by weight. Discarding and misreporting by the groundfish fishery have been negligible since 1992. Discards of haddock by the Canadian scallop fishery ranged between 29 and 186 mt since 1969 and were 67 mt in 2006.

USA catches in 2006 increased slightly to 591 mt from 569 mt in 2005. Landings were 445 mt and discards were estimated to be 146 mt.

For the **combined Canada/USA fishery catch in 2006**, the 2000 year class (age 6) and the 2003 year class (age 3) dominated by numbers and weight. The 2003 year class, again, did not contribute as much as expected due to its slower than anticipated growth rate.

Harvest Strategy and Reference Points

The Transboundary Management Guidance Committee has adopted a strategy to maintain a low to neutral risk of exceeding the fishing mortality limit reference, $F_{ref} = 0.26$. When

stock conditions are poor, fishing mortality rates should be further reduced to promote rebuilding.

State of Resource

The state of the resource was based on results from an age structured analytical assessment (VPA) that used fishery catch statistics and sampling for size and age composition of the catch for 1969 to 2006 (including discards). The VPA was calibrated to trends in abundance from three bottom trawl survey series; NMFS spring, NMFS fall and DFO. Data to approximate the age composition of the catch during 1931 to 1955 were used to reconstruct a population analysis of eastern Georges Bank haddock that was suitable for comparison of productivity. Retrospective analyses were used to detect any patterns to consistently overestimate or underestimate fishing mortality, biomass and recruitment relative to the terminal year estimates. This stock assessment does not display a retrospective pattern.

Improved **recruitment** in the 1990s and the strong 2000 year class, lower exploitation, and reduced capture of small fish in the fisheries allowed the **population biomass** (ages 3+) to increase from near an historical low of 8,500 mt in 1993 to 69,500 mt in 2003 (Figure 2). Adult biomass decreased to 46,900 mt in 2005 but subsequently increased to 145,300 mt (80% Confidence Interval: 113,000 mt – 200,000 mt) in 2007, higher than the 1931-1955 maximum biomass of about 90,000 mt. The marked increases in 2006 and 2007 are due to the exceptional 2003 year class, estimated at 321.7 million age-1 fish, the largest in the assessment time series (1931-1955 and 1969-2006). In contrast, the 2001, 2002 and 2004 year classes, at less than 8 million, are below the 18 million average of the 10 most recent year classes (excluding the 2003 year class). The 2005 year class (30.5 million age-1 fish) is well above the 10 year average. Initial estimates of the 2006 year class suggest that it is about the size of the 2004 year class.

Fishing mortality for ages 4+ fluctuated between 0.2 and 0.4 during the 1980s and showed a marked increase between 1989 and 1993 to about 0.6, the highest observed. During 1995-2004, fishing mortality was below the reference, $F_{ref} = 0.26$, but exceeded F_{ref} in 2005 and 2006 ($F_{2006} = 0.36$; 80% Confidence Interval: 0.28 – 0.49) (Figure 1).

Productivity

Recruits per spawner, age structure, spatial distribution and fish growth reflect changes in the productive potential. The recruits per adult biomass ratio was generally low during the 1980s but higher during the 1990s, comparable to that of the 1931 to 1955 period, suggesting that higher recruitment might occur, as the biomass is above 40,000 mt (Figure 3). However, in the early 2000's, excepting 2003 and 2005, recruits per spawner were again low. In both absolute numbers and percent composition, the **population age structure** displays a broad representation of age groups, reflecting improving recruitment and lower exploitation, particularly at younger ages, since 1995. The **spatial distribution** patterns observed during the most recent bottom trawl surveys were similar to the average patterns over the previous ten years. Consistent with the pattern observed for

previous large year classes, the exceptional 2003 year class, the main component of the 3+ age group, was widely distributed throughout the survey area. Both **length and weight at age** have declined since about 2000. While size at age increased in 2007 for most ages, weights remained about 40% to 50% below the average during 1986 to 2000. The size at age for the 2003 year class is smaller than previous year classes. DFO survey average weights at length, used to reflect fish **condition,** exhibit a declining trend but improved during 2006. With expanded age structure, broad spatial distribution and generally higher recruit per spawner ratio, resource productivity is high, negatively impacted only by recent reductions in fish size at age.

Outlook

This outlook is provided in terms of consequences with respect to the harvest reference points for alternative catch quotas in 2008. Uncertainty about standing stock generates uncertainty in forecast results which is expressed here as the risk of exceeding F_{ref}=0.26. The risk calculations assist in evaluating the consequences of alternative catch quotas by providing a general measure of the uncertainties. However, they are dependent on the data and model assumptions and do not include uncertainty due to variations in weight at age, partial recruitment to the fishery, natural mortality, systematic errors in data reporting or the possibility that the model may not reflect stock dynamics closely enough. To characterize the dependence of the projection results on the fishery partial recruitment for the 2003 year class, a sensitivity analysis was done to augment the risk analysis.

For projections, the weights at age and fishery partial recruitment at age for the 2003 year class were derived by accounting for recent trends in reduced growth rate. Assuming a 2007 catch equal to the 19,000 mt total quota, a combined Canada/USA catch of 26,700 mt in 2008 results in a neutral risk (50%) that the 2008 fishing mortality rate will exceed F_{ref} = 0.26 (Figure 4) and adult biomass is projected to be 145,000 mt at the beginning of 2009. A catch of 23,000 mt in 2008 results in a low risk (25%) that the 2008 fishing mortality rate will exceed F_{ref}.

Special Considerations

The outstanding 2003 year class was expected to contribute 66% of the 2006 catch numbers but accounted for only 28%. The contribution was less than predicted due to lower than anticipated recruitment to the fishery. The failure of this year class to contribute as expected to the fishery resulted in more of the 2000 and older year classes being caught in 2006 than had been projected from the 2005 assessment. This generated a fishing mortality above F_{ref} on the older ages in 2006. Slow growth of the 2003 cohort will continue to impact the fishery. If the TAC in 2007 is caught, fishing mortality will, again, be higher than F_{ref} on the fully recruited ages (F_{5+}=0.33) because the 2007 age 4 fishery partial recruitment is now estimated at 0.2 compared to 0.3 from the 2006 assessment.

While best judgement was used to determine the fishery partial recruitments for the reduced weight of the 2003 year class, the risk analysis does not capture the extent of

uncertainty of the consequences for various catch levels. Using the observed range of partial recruitment at weight during 1995 to 2006, the 2008 projected catch could vary from 17,000 mt to 31,000 mt. If the realized partial recruitment is near the higher end of the observed partial recruitment range, the fishery could forego available yield, if it is lower, the 4+ fishing mortality could be higher than F_{ref}.

Cod and haddock are often caught together in groundfish fisheries, although their catchabilities to the fisheries differ and they are not necessarily caught in proportion to their relative abundance. With current fishing practices and catch ratios, the achievement of rebuilding objectives for cod may constrain the harvesting of haddock. Modifications to fishing gear and practices, with enhanced monitoring, may mitigate these concerns.

Source Documents

TRAC. 2007. O'Boyle R, O'Brien L, editors. Proceedings of the Transboundary Resource Assessment Committee (TRAC); 12–15 June 2007. TRAC Proceedings 2007/(in prep.).

Van Eeckhaute L, Traver M, Mayo R. 2007. Assessment of haddock on eastern Georges Bank for 2007. TRAC Reference Document 2007/(in prep.).

Correct Citation

TRAC. 2007. Eastern Georges Bank Haddock. TRAC Status Report 2007/02.

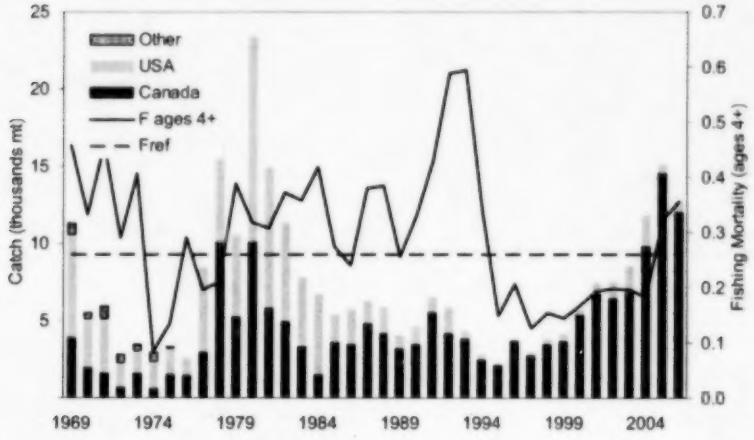


Figure 1. Catches and fishing mortality.

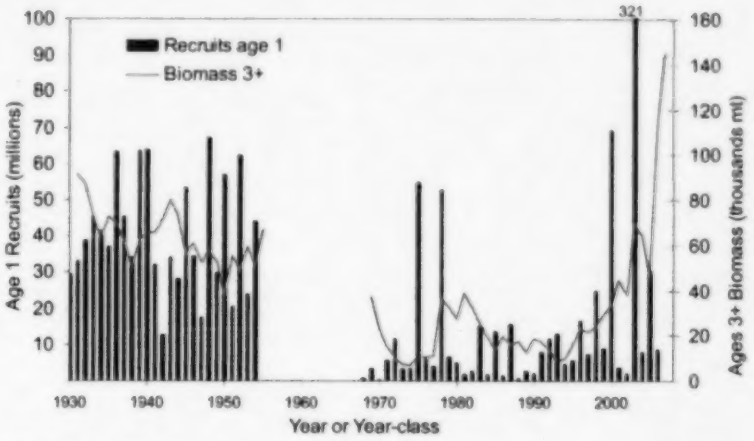


Figure 2. Biomass and recruitment.

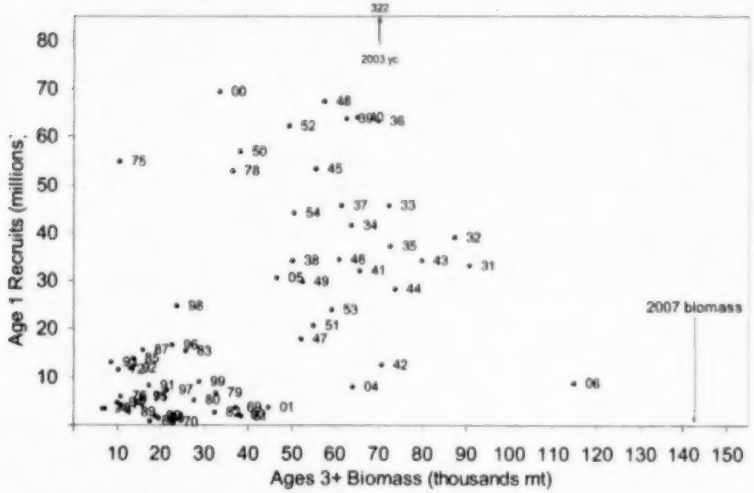


Figure 3. Stock recruitment patterns.

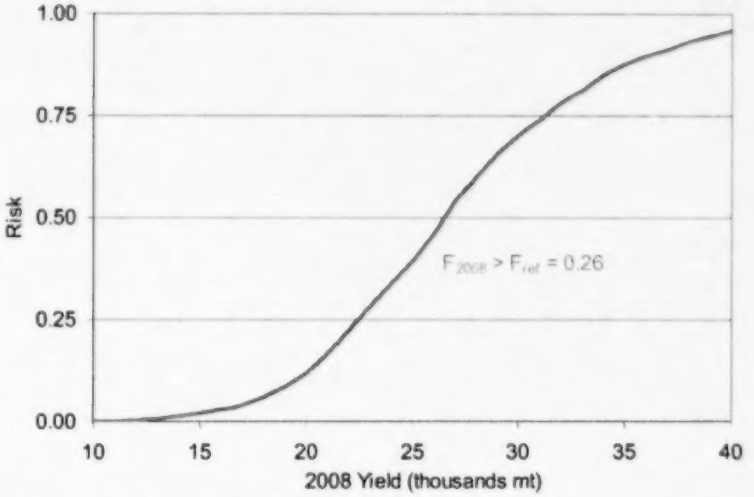


Figure 4. Projection risks.